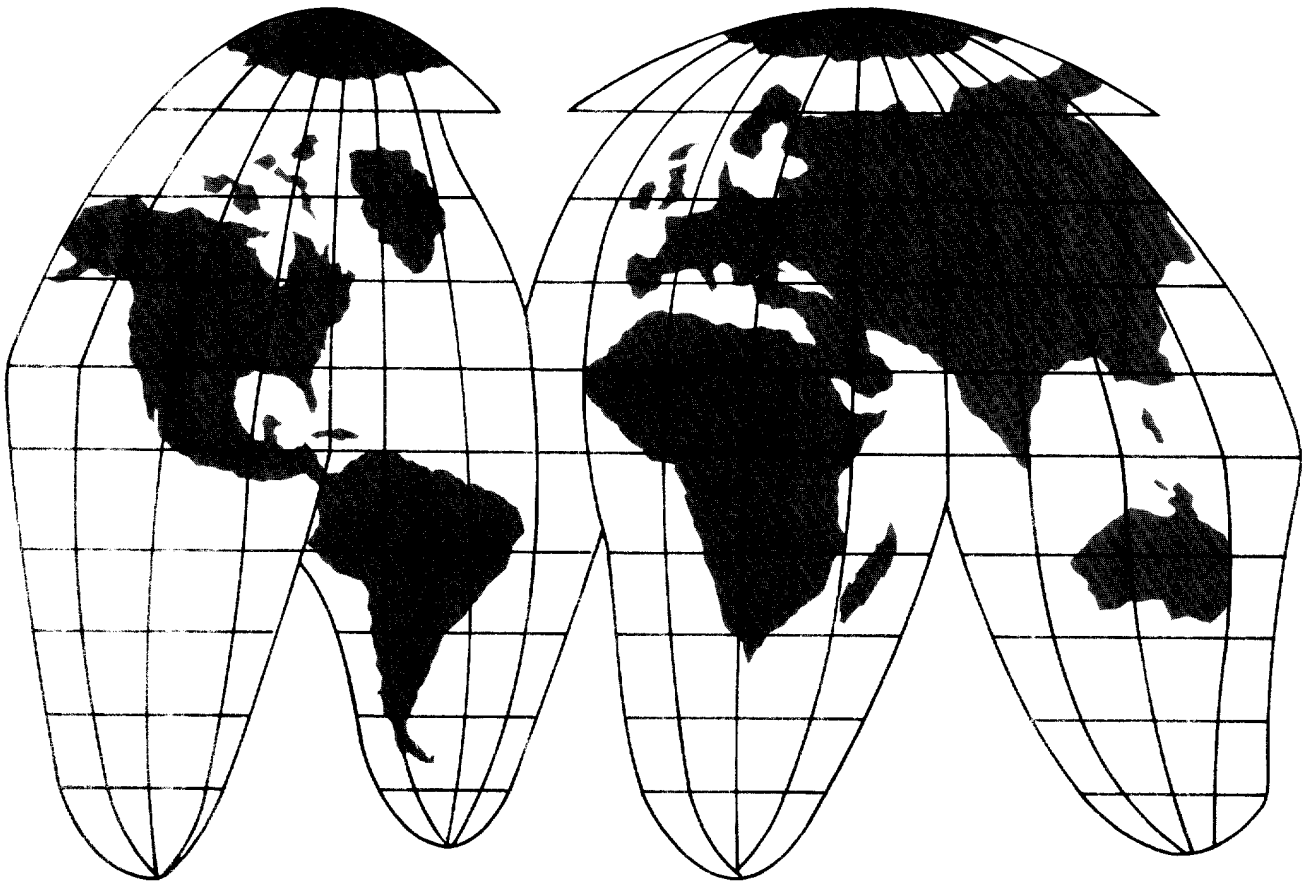
Bendix Banc-660
Navigation Computer System
for Automatic Dead Reckoning



Eclipse-Pioneer Division
TETERBORO, N. J.

THE Bendix CORPORATION

Approved For Release 2004/12/22 : CIA-RDP89B00739R000400160003-9

Bendix Banc-660 Navigation Computer System for Automatic Dead Reckoning

The Bendix BANC-660 Navigation Computer System advances aerospace navigation to provide continuous automatic dead reckoning in latitude and longitude coordinates; to compute the precise great circle course and distance to either of two destinations, and to solve wind triangles and provide presentation of ground-based data and free of any [illegible]

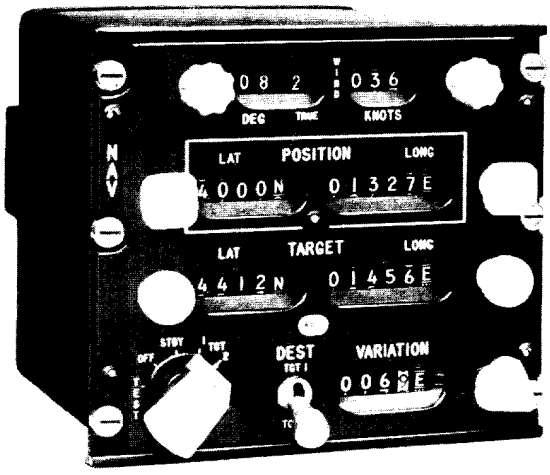
Accurate recall of target coordinates from the computer memory to permit maximum accuracy at termination of each flight leg * True "leap frog" capability for insertion of new target coordinates during flight without disturbing current steering computation * Remote target override capability * System capability for visual and radar position fixes * Complete module interchangeability for replacement without recalibration * Unimpeded modular layout for interference-free maintenance * Complete accessibility through removal of only the dust cover for unrestricted synchro trimming * I-beam support frames for reliable hard mounted operation under extreme vibration and shock environments * Shape-coded knobs for rapid identification of all functions * Reverse-color tenths digit on magnetic variation counter for accurate readout * Functionally grouped connectors for quick identification and ease of maintenance.

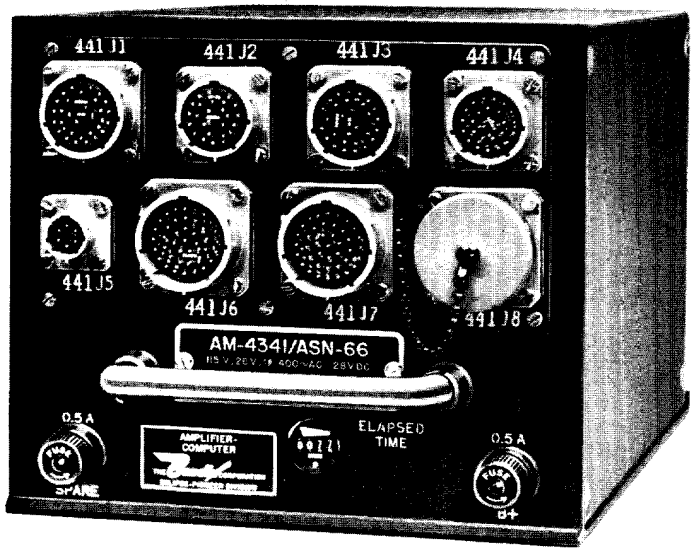
The System

The BANC-660 System embodies the knowmanship of the Eclipse-Pioneer Division — now in its fiftieth year — in successfully designing and producing instruments, components, and systems for aerospace control, guidance, and navigation. The result is a highly precise, reliable, and maintainable navigation computer system for automatic dead reckoning that exemplifies the most advanced state-of-the-art.

Designated as AN/ASN-66 for military use, the Bendix BANC-660 System incorporates three computers — Present Position, Course and Distance, and Wind Memory — in two compact units: the Computer Amplifier and the Computer Control. The units are completely modular and provide for integral self-testing.

Electrical outputs of bearing, distance, and ground track are compatible with standard Bearing-Distance-Heading Indicators (BDHI's) or Horizontal Situation Indicators (HSI's). Up to three indicators of these types may be driven by the system. Twelve other outputs of navigational data are provided, in addition to the displays of present position and computed wind. Optionally available are inertial ties, automatic magnetic variation, and true ground track synchro output.





On the Computer Control

OUTPUT	RANGE	2-SIGMA ACCURACY
Present Position Latitude	80°N-80°S (System operates beyond these limits with decreasing accuracy as poles are approached)	±0.25% of total path traveled or one nautical mile per hour, whichever is greater
Present Position Longitude	180°E-180°W, continuous	±0.25% of total path traveled at low latitudes, increasing to 1% at 80° N or S latitudes, or one nautical mile per hour, whichever is greater
Wind Velocity	0-250 knots	±3 knots
Wind Direction	0-360°, continuous	Varies with Wind Velocity from ±1° at 200 knots to ±3° at 25 knots

On BDHI's, HSI's, and other Displays

Note: All electrical outputs are wired for excitation from an external source, normally the using system.

FUNCTION	RANGE	ACCURACY
Distance to Target	0-2000 nautical miles (One synchro transmitter for each digit plus a switch actuated at 1000 miles)	Long Range (200-2000NM): 1% of distance plus five miles. Short Range (0-200NM): 0.5% of distance plus one mile
Bearing Relative to Heading	0°-360° (synchro)	Consistent with termination accuracy or ±1.0°. As read on BDHI
Ground Track Relative to Heading	0°-360° (synchro)	±1.0°. As read on BDHI

Additional Electrical Outputs

OUTPUT	RANGE	ACCURACY
Present Position Latitude	Dual speed synchro (35:1), covering latitude range	± ½ min of panel indication
Present Position Longitude	Dual speed synchro (35:1), 180°E-180°W, continuous	± ½ min of panel indication
Ground Speed	Synchro or dual section potentiometer, 0-1000 knots	±0.2%
Drift Angle	Synchro, 0°-360°, continuous	±0.25°
True Heading	Synchro, 0°-360°, continuous	±0.25°
Course Steering Error	Synchro, 0°-360°, continuous	±1° } Consistent with termination accuracy
True Bearing	Synchro, 0°-360°, continuous	±0.75° } Consistent with termination accuracy
E-W Distance	Synchro, 2 NM/rev	±0.25% of distance traveled
N-S Distance	Synchro, 2 NM/rev	±0.25% of distance traveled
Radar Distance	Potentiometer, 0-150 miles	±0.5%

Inputs

Synchro: True Air Speed, Ground Speed, Drift Angle, and Magnetic Heading.
D-C Signal: Doppler Quality.
A-C Signal: Radar Fix.

Manual: Initial Present Position (Latitude and Longitude),
Target No. 1 (Latitude and Longitude),

Target No. 2 (Latitude and Longitude),
Magnetic Variation,
Wind Velocity, and Wind Direction (Air Mass Mode only).

Modes of Operation

The inclusion of a Wind Memory Computer Section within the system provides for three modes of operation that are automatically actuated, dependent upon external system considerations.

Doppler

The computer receives Ground Speed and Drift Angle from the Doppler Radar System, True Air Speed from an Air Data or Air Speed Computer System, and Magnetic Heading from the Compass or Azimuth Reference System.

The Ground Speed vector formed is used for dead reckoning and is also compared with the Air Speed vector to provide a continuous solution of Wind Direction and Wind Velocity.

Wind Memory Mode

The Wind Memory Mode is automatically actuated when the Doppler Quality Signal indicates either a temporary drop-out of a return or that an enforced Doppler silence procedure is initiated. The Wind Memory Computer then retains the last value of the Wind vector computed When the Doppler System was operating properly and combines it with the current Air Speed vector to form the new Ground Speed vector.

Air Mass Mode

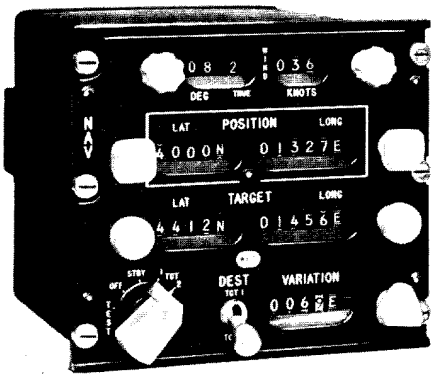
When the Doppler System is completely inoperative, manually inserted wind settings based on meteorological data are added to the Air Speed vector to solve for the Ground Speed vector. The instrumentation is identical to that used in the Memory Mode.

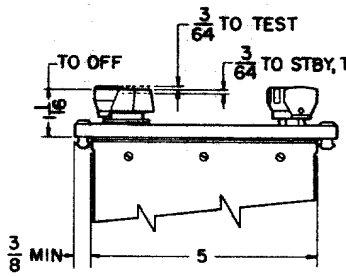
Environment

The Bendix BANC-660 system is designed for operation over the range of environmental conditions called out in MIL-E-5400 (ASG) Class 2.

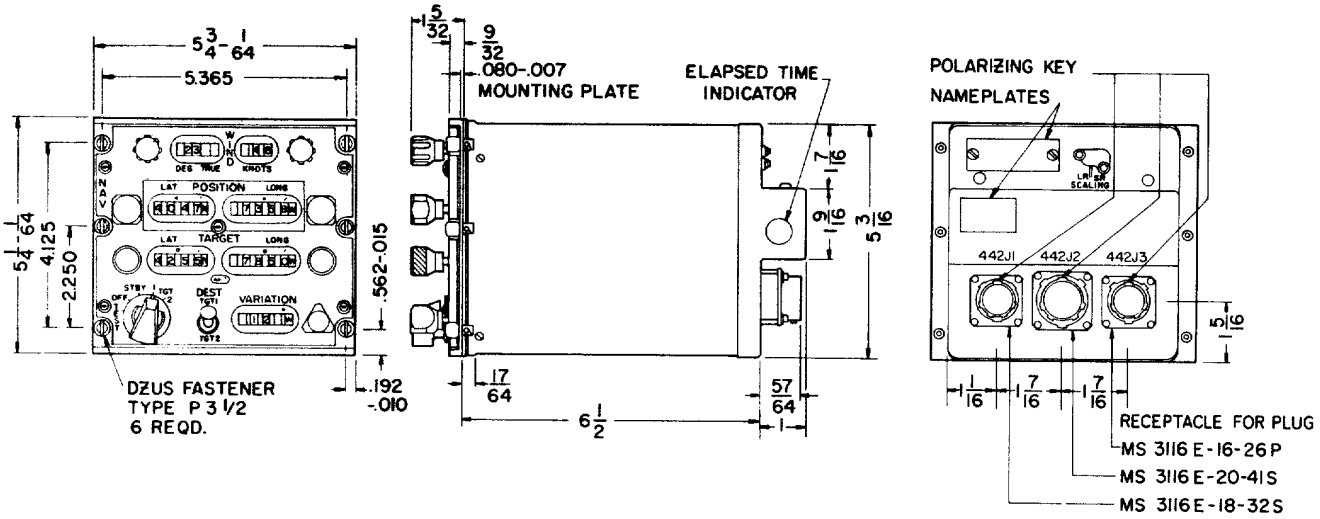
Computer Control

Size: 5¾ inches wide, by 5¼ inches high, by 6½ inches deep, excluding the connectors. Weight: 11 pounds.





NOTE:
ALTERNATE TYPE MS 3126 CONNECTORS (CRIMP TYPE) MAY BE SUBSTITUTED FOR MATING CONNECTORS SPECIFIED



This console-mounted unit is divided into six subassemblies — Chassis Assembly, Null Detector, Wind Module, Latitude Module, Longitude Module, and Variation Module — all mounted within a dust-tight cover. The modules are easily removable from the chassis frame. Three Bendix-Scintilla Type PT connectors are located at the rear of the unit.

Manual Controls Panel Presentation

Wind Direction and Wind Velocity Knobs

Air Mass Mode only: Knobs provide for manual insert on of true wind direction and wind velocity inputs. Simultaneously set respective counters for visual reference. Data is obtained from meteorological forecasts or from estimates based on known error accumulation during flight.

Wind Direction and Wind Velocity Counters

Air Mass Mode: Cyclometer-type counters display manually inserted 1) true wind direction input in one-degree increments from 0° to 360°, 2) wind velocity input in one-knot increments from 0 to 250 knots. Display remains fixed until manually changed or until Doppler-Normal-Mode of operation is automatically actuated.

Doppler, or Normal Mode: Counters change continuously during flight to display current wind information.

Wind Memory Mode: Counters display values of wind information current when Doppler was last operating. Display remains fixed until manually changed or until Doppler — or Normal — Mode of operation is automatically reactuated.

Magnetic Variation Knob

Knob provides for manual insertion of magnetic variation input. Simultaneously sets counter for visual reference. Data is obtained from charts of local areas, usually the average variation for the area to be traversed.

Magnetic Variation Counter

Cyclometer-type counter displays manually inserted magnetic variation input in one-tenth degree increments to 180° E and 180° W.

Function Switch

For selection of any of the operational functions or self-test.

TEST — Simulated inputs of Air Speed, Ground Speed, Drift Angle, and Heading are applied to the input servos to permit integrity self-testing of the computer.

OFF — System is inoperative.

STANDBY — Suspension of present position computation to permit visual fix procedure.

TARGET 1 — TARGET 2:

PRIOR TO FLIGHT — With function switch pulled out in target position 1 or 2, target data is inserted.

DURING FLIGHT — With function switch depressed at target position 1 or 2, applicable target coordinates are recalled from the system memory for display on the target latitude and longitude counters.

With function switch pulled out at target position 1 or 2, the logic of the applicable target switching circuit is reversed to permit setting new coordinates into the appropriate target memory.

Destination Switch

The destination switch is used to select the desired target coordinates, either 1 or 2, for transmission of steering computation signals to BDHI's, HSI's, or equivalent displays to indicate great circle bearing and distance from aircraft's present position to the particular target selected.

Wait Light

Amber light indicates when steering servos are not at null; when light is out new targets may be inserted.

Position Display: Latitude and Longitude Knobs

Knobs provide for manual insertion of initial present position coordinates. Simultaneously set counters for visual reference. Knobs are used in visual fix procedure. In-flight adjustment of the knobs is permissible.

Latitude and Longitude Counters

The counters will continually change to display the present position of the aircraft during flight in degrees and minutes of latitude and longitude. They are marked in one-minute increments.

Target Display: Latitude and Longitude Knobs

Provide for manual insertion of target coordinates. Simultaneously set counters for visual reference. Targets may be changed at will during flight without disturbing steering computation to current destination.

Latitude and Longitude Counters

Display target position in degrees and minutes of latitude and longitude in one-minute increments.

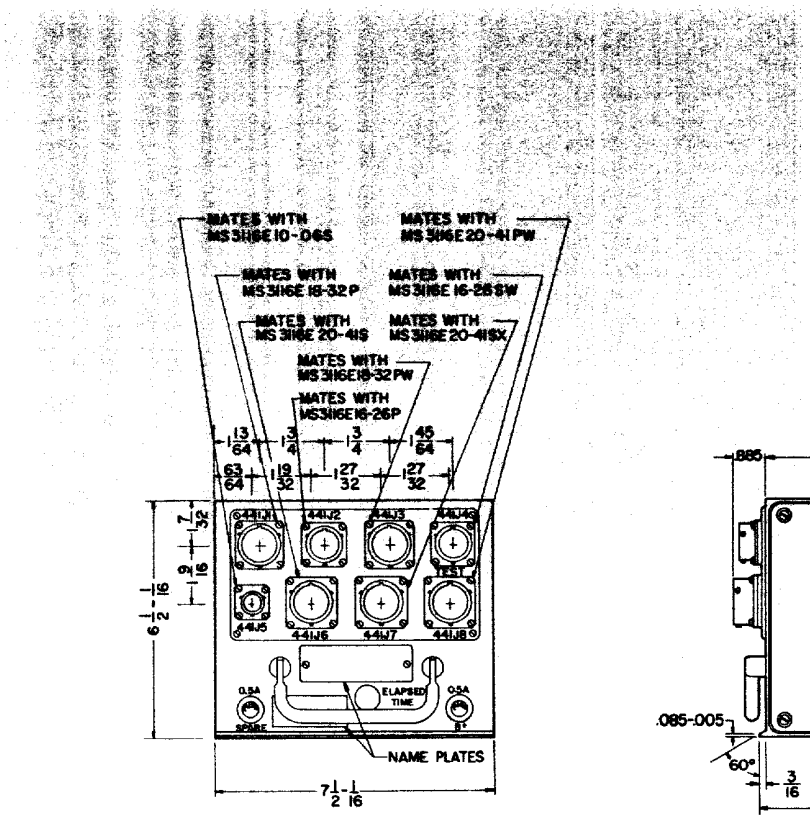
Computer Amplifier

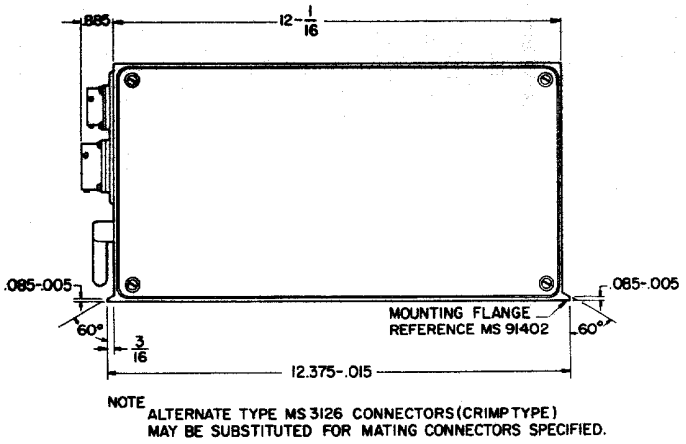
This compact unit houses six electromechanical modules and the system's electronic circuitry. The modules, which are removable for easy servicing, are: Velocity, Latitude Memory, Longitude Memory, Ground Track, Range (Distance), and Bearing. The electronics includes a plug-in power supply at the rear wall of the amplifier unit, and the following printed circuit cards: Four cards that comprise the velocity-to-distance integrator — namely, a frequency converter, a resolver driver, a zero crossing detector, and a binary divider; two step motor drive cards; and two cards to provide the proportional radar fix circuitry.

All system primary power is applied to this unit. The required power is 175 volt-amperes of 115-volt, 400-cycle-per-second, single-phase, and one ampere of 28 volts DC, in accordance with MIL Standard 704, Category B. Seven Bendix-Scintilla Type PT connectors provide for system interconnection. One additional Type PT connector serves as a system test board for trouble-shooting purposes.

The form factor of the unit is not rigidly determined by the components it houses; it can be altered, within limits, to suit particular installation requirements.

Size: 6½ inches high, by 7½ inches wide, by 12 inches long. Weight: 24 pounds.





NOTE ALTERNATE TYPE MS 3126 CONNECTORS (CRIMP TYPE) MAY BE SUBSTITUTED FOR MATING CONNECTORS SPECIFIED.

AN/ASN-66

Target mode operation

ENROUTE OPERATIONS

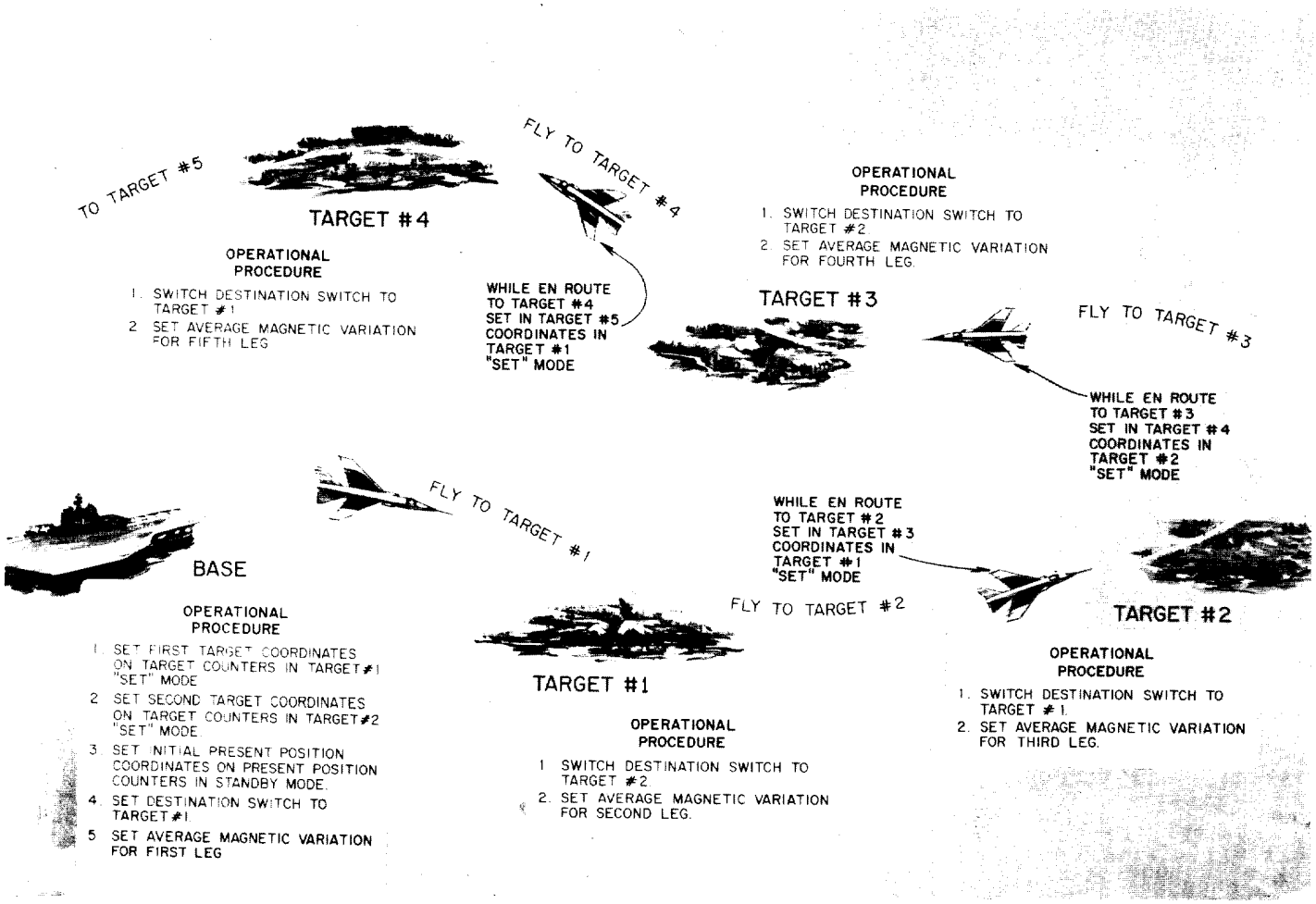
A. *Target Recall and Change* — Targets may be recalled and changed at any time during flight by leap-frogging without disturbing the steering computation to the current target. Thus, after reaching target 1 and enroute to target 2, a new target 1 may be inserted. After reaching target 2, enroute to the new target 1, a new target 2 may be inserted, continuing up to the range capability of the aircraft. When necessary, a flight plan may be completely altered, and both targets changed concurrently.

B. *Position Fix* — A present position fix may be made at any time during flight by correcting the readout on the position counters.

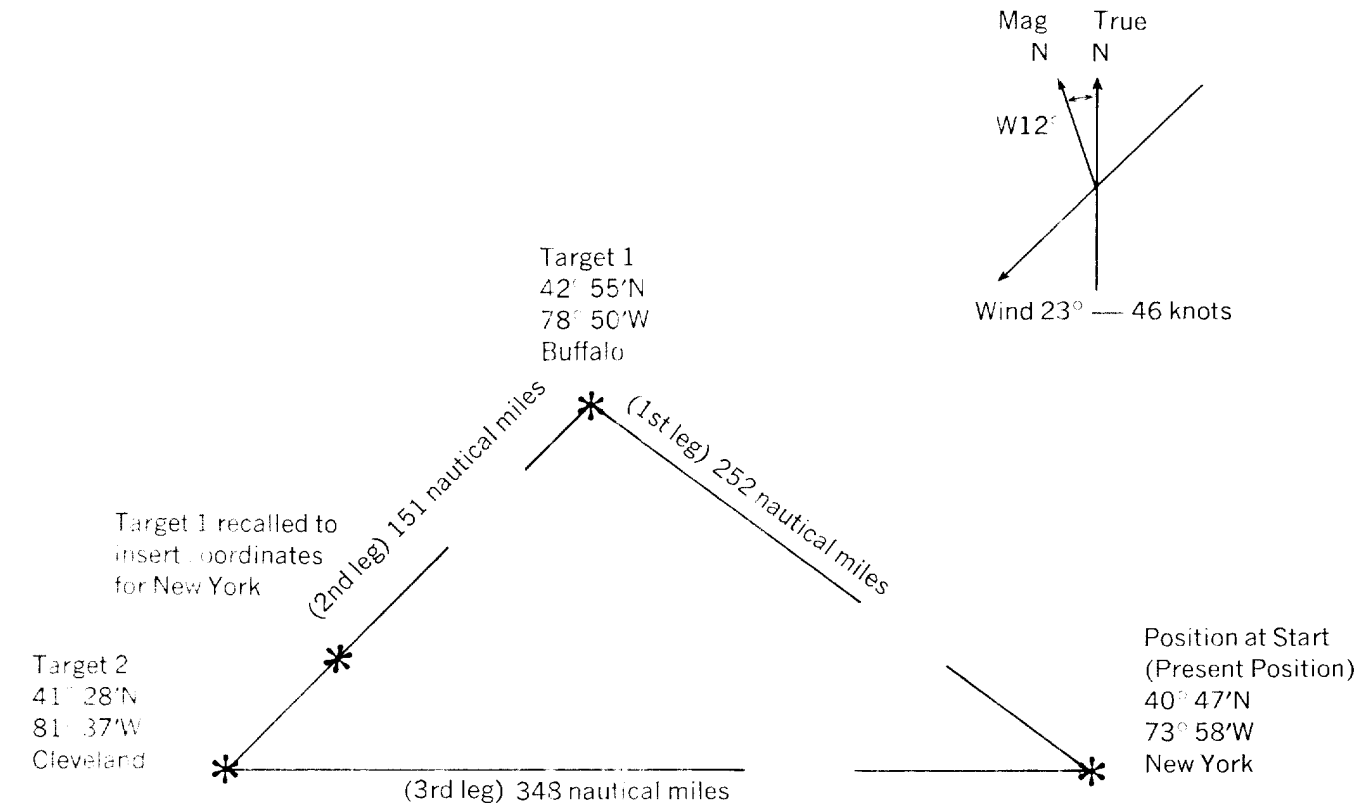
C. *Radar Fix* — Either target 1 or target 2 may be used for radar position fixing.

D. *Magnetic Variation* — The magnetic variation in any given area must be manually changed during flight, as required, regardless of operational mode. The average value of variation for each flight leg is normally used for the entire flight leg.

E. *Wind Direction and Velocity* — In Air Mass Mode only, wind direction and velocity must be manually changed during flight, as required.



Typical Non-stop Flight —Two Targets and Return

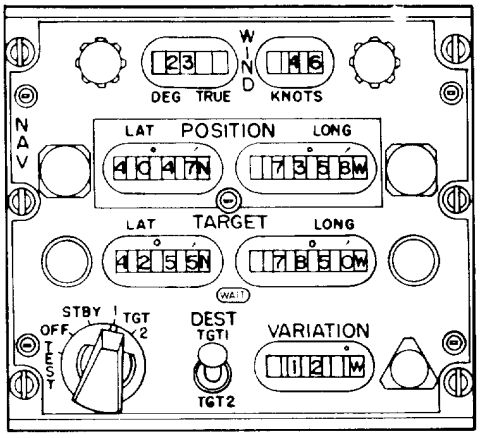


1st LEG
NEW YORK TO BUFFALO
Target 1: Buffalo
Great Circle Bearing to Target 1: 302°
Ground Track Angle: 302°

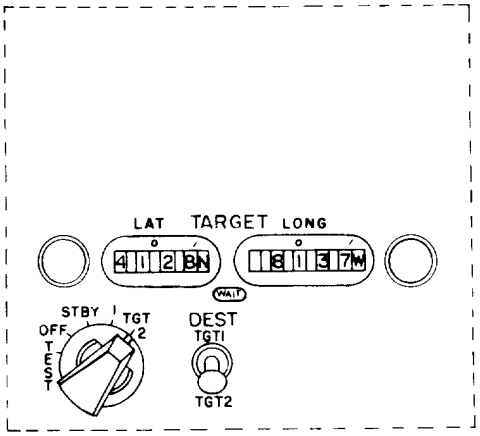
2nd LEG
BUFFALO TO CLEVELAND
Target 2: Cleveland
Great Circle Bearing to Target 2: 236°
(Enroute: Recall Target 1 and insert coordinates for New York)
Ground Track Angle: 236°

3rd LEG
CLEVELAND TO NEW YORK
Target 1 (New): New York
Great Circle Bearing to Target: 94°
Ground Track Angle: 94°

COMPUTER CONTROL SETTINGS



Final — Before Take-off



Target 2 — Destination 2 Positions

PRIOR TO FLIGHT

A. *Magnetic Variation* — Insert manually for all modes, with function switch in any position.

B. *Wind Direction and Velocity* — Insert manually for Air Mass Mode only, with function switch in any position; automatically derived in Doppler Radar Mode.

C. *Target 1, Buffalo, and Target 2, Cleveland* — Insert coordinates manually for all modes. Function switch must be pulled out at the desired target setting. Either target may be inserted first. Only one target at a time is displayed, depending on position of function switch.

D. *Position at Start (Present Position), New York* — Insert coordinates manually for all modes, with function switch at Stby.

FLIGHT — FIRST LEG

A. After take-off, assume heading for Buffalo, 302°.

B. Turn function switch to target 1, Buffalo, and set destination switch to target 1.

C. With both the function and destination switches at target 1 —

Position counters will continuously change to show present position enroute to Buffalo.

Target counters will remain fixed to show target 1, Buffalo, coordinates.

Wind counters, in Doppler Radar Mode, will change to show prevailing wind conditions.

Associated BDHI's or HSI's will show great circle bearing and distance to Buffalo, and ground track angle relative to heading.

D. When target 1, Buffalo, is reached, the present position counters will read the same as the target counters.

FLIGHT — SECOND LEG

A. When on target 1, Buffalo, change heading for Cleveland, target 2, 236°.

B. Turn function switch to target 2, Cleveland, and set destination switch to target 2.

C. With both the function and destination switches at target 2 —

Position counters will continuously change to show present position enroute to Cleveland.

Target counters will remain fixed to show target 2, Cleveland, coordinates.

Wind Counters, in Doppler Radar Mode, will change to show prevailing wind conditions.

Associated BDHI's and HSI's will show great circle bearing and distance to Cleveland, and ground track angle relative to heading.

D. With destination switch at target 2, Cleveland, and function switch at target 1, Buffalo —

Position counters will continuously change to show present position enroute to Cleveland.

Target counters will change and remain fixed to show target 1, Buffalo, coordinates.

Wind counters, in Doppler Radar Mode, will change to show prevailing wind conditions.

Associated BDHI's or HSI's will show the great circle bearing and distance to Cleveland, and ground track angle relative to target 2, Cleveland.

E. At some point enroute to Cleveland, recall target 1, Buffalo, coordinates, and insert New York coordinates. Set function switch to target 1 in pulled-out position, which nulls target 1 coordinates. Insert New York coordinates, the new target 1. Push-in function switch.

Turn the function switch to target 2 and continue on course to Cleveland. Changing the position of the function switch will cause the system to display the same type of information as displayed during the first leg of the flight, except that coordinates are now for Cleveland and New York instead of Buffalo and Cleveland.

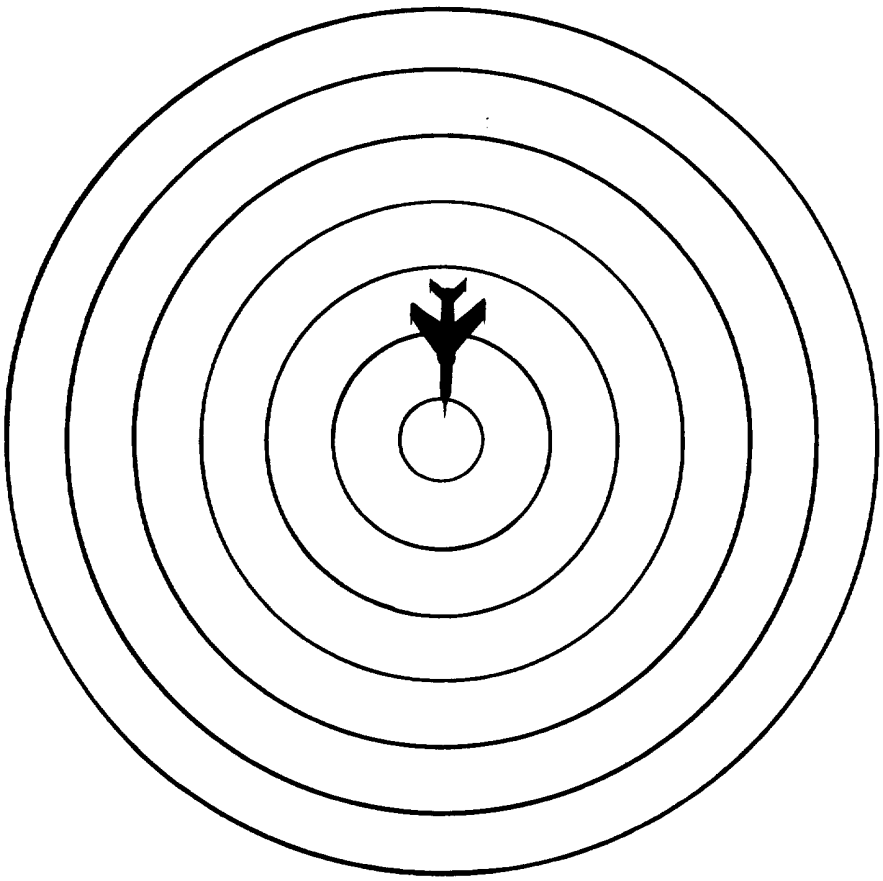
F. When target 2, Cleveland, is reached, the present position counters will read the same as the target counters (with function switch at target 2).

FLIGHT — THIRD LEG — HOME

A. When on target 2, Cleveland, change heading for New York, new target 1, 94°.

B. Turn function switch to target 1, New York, and set destination switch to target 1.

FOR ADDITIONAL INFORMATION, PLEASE CONTACT ANY OF THE FOLLOWING OFFICES . . . FACTORY SALES: The Bendix Corporation, Eclipse-Pioneer Division, Teterboro, New Jersey 07608—Telephone: (201) 288-2000 • **REGIONAL OFFICES: Alabama** The Bendix Corporation, Eclipse-Pioneer Division, 3322 Memorial Highway, South, Huntsville, Alabama 35801—Telephone: (205) 881-1912 • **California** The Bendix Corporation, Western Regional Sales Office, Eclipse-Pioneer Division, 6151 West Century Boulevard, Los Angeles, California 90045—Telephone: (213) 776-4100 or 679-8047 • The Bendix Corporation, Eclipse-Pioneer Division, 128 El Camino Real, San Carlos, California 94070—Telephone: (415) LYtel 3-7845 • The Bendix Corporation, Eclipse-Pioneer Division, 808 East Mill Street, San Bernardino, California 92410 —Telephone: (213) TU 9-0016 • **District of Columbia** The Bendix Corporation, Eclipse-Pioneer Division, 1730 "K" Street, N.W., Washington, D. C. 20006—Telephone: (202) FEderal 3-8200 • **Ohio** The Bendix Corporation, Eclipse-Pioneer Division, 1900 Hulman Building, Dayton, Ohio 45402—Telephone: (513) 461-3750 • **Texas** The Bendix Corporation, Eclipse-Pioneer Division, Suite 203, 1730 FM 528, Houston, Texas 77058—Telephone: (713) HUnter 8-1090 • **Washington** The Bendix Corporation, Eclipse-Pioneer Division, 8425 First Avenue, South, Seattle, Wash. 98108—Telephone (206) PArkway 5-9100 • **Canada** Aviation Electric, Ltd., P.O. Box 2140, St. Laurent, Montreal 9, Quebec, Canada—Telephone: (514) RIverside 4-2811 • **EXPORT SALES:** The Bendix Corporation, Bendix International Operations, 605 Third Avenue, New York, N. Y. 10016—Telephone: (212) 973-2121.



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